

AEROLOGICAL OBSERVATIONS

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Mean free-air data based on airplane weather observations during the month of October 1937 are given in tables 1 to 3. A description of the methods by which the various monthly means and normals therein are computed may be found in the aerological section of the MONTHLY WEATHER REVIEW for January and March 1937.

It will be noted that many of the "normals" are based on only 3 years of observation. Conclusions based on departures from such short-period normals must be used with caution.

The mean surface temperatures for October (see chart 1) were above normal in the western half of the country and below normal in the eastern half. The positive departures in the west averaged perhaps between 1.5° and 2° C., while the negative departures in the east averaged perhaps 0.5° C., lower in absolute value. The maximum values ranged between $+2.2^{\circ}$ and $+3.9^{\circ}$ C., mostly concentrated over the Northwestern States. The maximum departures of opposite sign were neither so pronounced nor so concentrated in the east, the extreme reported being -3.1° C., followed by -2.3° C., with a tendency for fairly well-marked departures to occur near the Great Lakes and southward for a considerable distance.

The mean free-air temperatures for the month up to 5 kilometers were generally below normal by moderate amounts (-1° to -4° C.) in the eastern part of the country except over the extreme southern portion at elevations from 4 to 5 kilometers where they were above normal by slight amounts. The free-air temperatures were slightly above normal over the extreme southwest and perhaps the central portion of the Western Plateau. Over the Northwestern States the departures from normal temperature were positive by slight or moderate amounts near the ground up to elevations of 1 to 2.5 kilometers (M. S. L.), but they were negative by similar amounts at higher elevations. The most pronounced departures from normal of the free-air temperatures were those of negative sign over the northeastern sector of the country especially near the Great Lakes where values approximately from -2° to -4° C. prevailed. Elsewhere the departures appeared to be rather inconsequential.

The mean free-air relative humidities and specific humidities are given in table 2. The mean relative humidities for the month over the eastern part of the country were generally close to normal with small positive or negative departures (plus or minus, 1 to 6 percent) near the surface but small, moderate, or large positive departures ($+1$ to 18 percent) at higher elevations. An exception to this statement must be made with regard to the extreme southern portion of the area in question, where small or moderate negative departures (-1 to -11 percent) occurred above the surface stratum. Generally speaking the greatest positive departures ($+11$ to $+18$ percent) occurred over and near the New England coastal area and the eastern Great Lakes in association with the pronounced negative departures of temperature referred to above. Over the north-central portion of the country the humidities were mostly in excess of normal to a slight or moderate extent. The same situation prevailed at elevations from 2 to 5 kilometers over the extreme south-central portion (see Kelly Field, San Antonio, Tex.), while at lower elevations the humidities were deficient to a similar extent. Between the latter two areas the humidities were subnormal to a slight degree. Over the extreme northwest corner of the coun-

try the departures of mean humidities from the normal were mostly positive of moderate degree. Elsewhere the deviations from normal appeared to be of no great consequence.

Table 3 shows the monthly mean free-air barometric pressures and equivalent potential temperatures. The lowest mean pressure over continental United States prevailed over the northern Great Lakes and the highest prevailed over the extreme south-central portion of the country. The distribution of pressures was such as to produce cyclonic curvature of the mean monthly isobars about a center near Sault Ste. Marie, Mich., and practically straight east-west isobars over the southern part of the country, except near the ground. A secondary minimum of mean barometric pressure occurred over Salt Lake City, Utah, at 5 kilometers. At the same elevation, the mean pressure over Cheyenne was notably high compared to adjacent stations to east and west (Omaha, 547 millibars; Cheyenne, 551 millibars; Salt Lake City, 546 millibars). As in the normal course, the mean north-south pressure gradients for October increased with respect to those for the preceding month; specifically they increased between 44 and 86 percent at elevations 1 to 5 kilometers along the line from Pensacola to Sault Ste. Marie, Mich. Increases were especially pronounced from Oakland to Sault Ste. Marie, viz., $+267$ to 100 percent, and from Billings to Sault Ste. Marie, viz., 150 to 200 percent, at elevations 2 to 5 kilometers.

Table 4 shows the free-air resultant winds based on pilot-balloon observations made near 5 a. m. (75th meridian time) during October. Except in the lower kilometer or so above sea level and at higher levels also over certain stations near the Pacific coast, the resultant wind directions for the month were generally close to normal. With approximately the same exceptions plus a considerable proportion of the western plateau from about 3 to 5 kilometers where resultant velocities were deficient in many cases, the resultant velocities were generally in excess of normal by slight to moderate amounts, viz., 1 to 6 m. p. s. The departures exceeding $+3$ m. p. s. were mostly concentrated over the southeastern part of the country. The negative departures were mostly slight except over Cheyenne at 5 kilometers, viz., -4.3 m. p. s.

In the lower kilometer stratum above sea level excluding the surface from consideration, stations in the north-central portion of the country exhibited monthly resultants which were oriented clockwise from normal by amounts ranging approximately from 30° to 90° . Orientations of similar amount, but counterclockwise in rotation, occurred in the resultants at several stations in the southeast. At 1 kilometer over Houston, Tex., the orientation from normal was about 170° (normal direction from N. 146°). Thus in the stratum near the ground, northwest or west-northwest resultant directions were the rule rather than the southwest to west directions over the north-central portion of the country and the northeasterly directions over the southeastern portion respectively which normally prevail, although the resultant velocities were generally subnormal by small amounts in these cases (viz., 0.5 to 2 m. p. s.) over the former area but super-normal by similar amounts over the latter.

With regard to stations near the west coast, the Medford, Oreg., monthly resultants were oriented from 40° to 70° counterclockwise from normal direction between 2 and 3 kilometers, i. e., more from the south than the

usual southwest or west. The Oakland, Calif., resultants from 2.5 to 3 kilometers were similarly oriented with respect to the normals (viz, 60° and 20°), in this case representing orientations more from the west than the customary NNW. and NW.

Table 5 shows the maximum free-air wind velocities and their directions for various sections of the United States during October as determined by pilot balloon observations. The extreme maximum was 51.6 m.p.s. from the SW. at 8,600 meters above sea level over Modena, Utah.

The mean monthly specific humidities and equivalent potential temperatures are shown in tables 2 and 3, respectively. The minima of both elements occurred in the vicinity of Sault Ste. Marie, Mich., while the maxima occurred near the extreme south-central part of the country or slightly to the west thereof. The distribution of the mean data under consideration gave lines of equal value whose configurations were similar in their major features to those of the mean monthly isobars previously discussed. From 1.5 to 4 kilometers there was evidence, however, of some anticyclonic curl of the lines in question over the southern half of the western plateau. This contrasted with the cyclonic curl over the north, especially, northeastern part of the country.

During October the western half of the country was mostly under the dominance of anticyclones of Pp origin which crossed the west coast from the Pacific. Temperatures in the lower strata over the area under consideration were warmer than usual, partly as a result of subsidence and dryness within the Pp air masses over the western plateau, intensity of the received insolation through the relatively clear air, the presumably warm character of these masses of air compared to the normal possibly due to the unusual southwestward displacement of the North Pacific high pressure area, and perhaps also the thermodynamic effects of frequent blocking of warm, moist air from the Gulf of Mexico by the anticyclonic circulation over the plateau. Precipitation was therefore rather scattered in the West and considerably deficient over extensive areas, particularly in the Dakotas, Minnesota,

southern California, Arizona, and the Texas Panhandle where only one-fourth of the normal or less was observed. On the other hand, precipitation was superabundant in a few small areas, viz, eastern Montana, western North Dakota, northern California, and southern New Mexico, where 150 percent of the normal amounts occurred. The rainfall here was generally associated with occluded front passages.

The eastern part of the country was frequently subject to the effects of outbursts of Pc air masses from the vicinity of central Canada southward and southeastward along or across the Mississippi Valley, thence eastward and northeastward out into the Atlantic Ocean. These outbursts of cold air produced abnormally cold weather from the Great Lakes southward for some distance and frequent alternations over the east of anticyclones with Pp or Pc air masses at the lower elevations, the former more commonly on the western portions and the latter on the eastern portions of the anticyclonic circulations. Important in this connection were the relatively strong pressure gradients which existed from the vicinity of Montana to northern Michigan, owing to the respective temperature and pressure distributions in the dominating air masses.

As the alternating anticyclones from the west, north-west, or north progressed so that their western flanks were in the vicinity of the Mississippi Valley, relatively warm, moist air from the Gulf of Mexico was able to move northward up the valley. When the movement of this air had prevailed for a sufficient time, ascent of the humid air up the flanks of the eastward moving anticyclones was productive of copious precipitation from Louisiana to the Great Lakes and eastward to the Atlantic. In fact, from two to three times the normal amounts fell in a narrow belt extending from the extreme lower Mississippi Valley to southeastern Pennsylvania and eastern Maryland. This precipitation was largely in association with cyclones which developed along the advancing fronts of the cold air masses or increased in intensity near the lower Mississippi Valley and moved east and northeastward.

TABLE 1.—Mean free-air temperatures (t), °C obtained by airplanes during October 1937. (Dep. represents departure from "normal" temperature)

Station	Number of obs.	Altitude (meters) m. s. l.																	
		Surface		500		1,000		1,500		2,000		2,500		3,000		4,000		5,000	
		t	Dep.	t	Dep.	t	Dep.	t	Dep.	t	Dep.	t	Dep.	t	Dep.	t	Dep.	t	Dep.
Barksdale Field ¹ (Shreveport), La. (52 m).	26	13.2	-1.1	15.5	-1.6	13.7	-1.4	12.6	-0.8	10.4	-0.8	7.5	-1.2	4.9	-1.4	1.1	-0.2	-----	-----
Billings, Mont. ¹ (1,090 m).	31	8.4	+1.2	-----	-----	-----	-----	10.4	+0.6	8.4	+0.4	5.3	+0.1	1.8	-0.2	-5.5	-0.7	-13.1	-1.6
Boston, Mass. ¹ (5 m).	27	9.0	-0.6	8.6	+0.1	6.1	-0.3	4.0	-0.8	1.8	-1.4	0.2	-1.1	-2.1	-1.3	-8.9	-1.0	-13.5	-1.4
Cheyenne, Wyo. ¹ (1,873 m).	30	5.7	+1.1	-----	-----	-----	-----	-----	-----	7.3	+0.8	7.9	+0.7	4.6	+0.4	-2.7	+0.2	-9.7	+0.3
Chicago, Ill. ¹ (187 m).	30	7.8	-1.0	7.9	-1.5	6.1	-2.0	4.1	-2.0	1.7	-2.4	-0.6	-2.3	-2.9	-2.0	-8.0	-1.8	-13.2	-1.3
Coco Solo, Canal Zone ² (15 m).	26	24.6	-----	23.9	-----	21.0	-----	18.4	-----	15.7	-----	13.2	-----	10.4	-----	4.3	-----	-1.5	-----
El Paso, Tex. ¹ (1,194 m).	31	14.1	+0.3	-----	-----	-----	-----	17.3	+0.4	14.7	-0.4	11.5	-0.8	7.7	-1.2	0.9	-0.9	-4.9	-0.7
Fargo, N. Dak. ¹ (274 m).	31	3.5	-0.3	5.6	-0.7	3.8	-2.0	2.4	-1.8	1.0	-1.4	-1.1	-1.1	-3.6	-1.2	-8.8	-1.1	-14.7	-1.0
Kelly Field (San Antonio), Tex. ¹ (206 m).	31	17.3	+0.5	19.3	-0.1	18.3	-0.5	16.1	-0.1	13.5	-0.6	11.1	-0.6	8.7	-0.3	3.0	-0.2	-3.0	+0.3
Lakehurst, N. J. ¹ (39 m).	24	6.2	-2.2	8.1	-1.4	4.9	-2.4	2.5	-3.2	0.5	-3.4	-1.5	-3.3	4.2	-3.7	-9.7	-4.1	-----	-----
Maxwell Field (Montgomery), Ala. ¹ (52 m).	16	16.7	+0.7	16.5	-1.6	14.0	-1.8	11.2	-2.1	9.2	-2.2	8.0	-1.5	5.9	-1.3	1.0	-0.3	-4.3	+0.5
Mitchel Field (Hempstead, L. I.), N. Y. ¹ (29 m).	21	8.9	-0.1	8.7	-0.4	6.1	-0.9	3.8	-1.6	2.3	-1.4	0.3	-1.3	-2.3	-1.7	-6.7	-1.4	-----	-----
Nashville, Tenn. ¹ (180 m).	30	12.0	0.0	12.6	-1.7	10.7	-1.9	8.5	-2.0	6.4	-1.9	4.3	-2.0	1.7	-2.1	-3.5	-1.7	-8.7	-1.1
Norfolk, Va. ¹ (10 m).	20	11.9	-2.1	12.5	-1.1	9.3	-1.7	7.5	-1.7	5.9	-1.5	3.6	-1.7	1.3	-1.8	-2.9	-1.1	-8.1	-0.6
Oakland, Calif. ¹ (2 m).	31	13.6	-----	16.4	-----	16.1	-----	14.1	-----	11.6	-----	8.4	-----	5.6	-----	-0.4	-----	-6.1	-----
Oklahoma City, Okla. ¹ (391 m).	31	12.1	-0.7	15.0	+0.2	14.8	-0.8	13.1	-0.9	10.8	-1.1	7.8	-1.3	4.8	-1.2	-0.6	-0.4	-6.7	-0.4
Omaha, Nebr. ¹ (300 m).	31	8.2	-0.2	10.4	+0.4	9.0	-1.0	8.3	-1.1	5.8	-1.7	3.1	-2.0	0.6	-1.8	-4.6	-1.0	-10.6	-0.6
Pearl Harbor, Territory of Hawaii ¹ (6 m).	31	22.6	-2.1	22.0	-0.2	18.6	+0.2	16.1	+0.6	14.1	+1.0	12.8	+1.2	10.8	+1.1	6.2	+2.3	0.2	+2.5
Pensacola, Fla. ¹ (13 m).	22	15.8	-1.7	17.8	-0.2	15.6	-0.3	13.2	-0.5	11.2	-0.5	8.9	-0.6	6.8	-0.3	2.6	+0.8	-2.7	+1.0
St. Thomas, Virgin Islands ¹ (8 m).	29	28.6	-----	24.6	-----	21.0	-----	18.2	-----	15.7	-----	13.5	-----	11.1	-----	6.0	-----	0.4	-----
Salt Lake City, Utah ¹ (1,288 m).	31	9.6	-----	-----	-----	-----	-----	12.6	-----	10.6	-----	7.3	-----	4.0	-----	-2.3	-----	-8.4	-----
San Diego, Calif. ¹ (10 m).	30	15.5	-1.9	17.1	-0.2	19.2	+1.4	17.1	+1.1	15.0	+1.2	12.6	+1.5	9.4	+1.2	3.3	+1.1	-2.7	+1.7
Sault Ste. Marie, Mich. ¹ (221 m).	29	5.0	-----	3.7	-----	0.4	-----	-1.6	-----	-2.8	-----	-4.8	-----	-7.1	-----	-12.4	-----	-18.2	-----
Scott Field (Belleville), Ill. ¹ (135 m).	24	7.0	-1.5	11.2	-1.6	9.3	-2.3	6.7	-2.7	4.5	-2.8	2.0	-3.4	-0.2	-3.1	-5.2	-2.6	-11.0	-2.6
Seattle, Wash. ¹ (10 m).	9	14.2	-----	14.3	-----	14.4	-----	13.0	-----	10.6	-----	8.0	-----	5.9	-----	0.3	-----	-6.2	-----
Selfridge Field (Mount Clemens), Mich. ¹ (177 m).	25	6.0	-1.0	6.1	-2.6	3.6	-3.2	1.1	-3.8	-1.0	-3.9	-2.8	-3.7	-5.5	-3.9	-10.7	-3.5	-17.2	-3.7
Spokane, Wash. ¹ (597 m).	31	7.8	+1.2	-----	-----	10.2	+0.5	8.3	-0.3	5.1	-1.1	2.0	-1.5	-0.9	-1.6	-7.2	-1.7	-14.4	-2.2
Washington, D. C. ¹ (13 m).	26	10.1	-1.4	10.1	-1.4	8.2	-1.6	5.6	-2.2	3.6	-2.3	1.7	-2.3	-0.7	-2.6	-5.7	-3.1	-11.3	-3.0
Wright Field (Dayton), Ohio ¹ (244 m).	25	6.4	-1.2	8.2	-2.0	6.2	-3.0	4.3	-3.0	2.1	-3.1	-0.2	-3.2	-2.4	-3.3	-6.8	-2.7	-12.6	-2.1

¹ Army.

² Weather Bureau.

³ Navy.

Observations taken about 4 a. m. 75th meridian time, except by Navy stations along the Pacific coast and Hawaii where they are taken at dawn.

NOTE.—The departures are based on normals covering the following total number of observations made during the same month in previous years, including the current month (years of record are given in parentheses following the number of observations): Barksdale Field, 80 (3); Billings, 122 (4); Boston, 122 (5); Cheyenne, 123 (4); Chicago, 89 (3); El Paso, 92 (3); Fargo, 123 (4); Kelly Field, 111 (4); Lakehurst, 108 (4); Maxwell Field, 106 (4); Mitchel Field, 92 (4); Nashville, 123 (4); Norfolk, 178 (8); Oklahoma City, 123 (4); Omaha, 217 (7); Pearl Harbor, 164 (6); Pensacola, 218 (9); San Diego, 227 (9); Scott Field, 88 (4); Selfridge Field, 118 (4); Spokane, 122 (4); Washington, 222 (10); Wright Field, 109 (4).

TABLE 2.—Mean free-air relative humidities (*R. H.*), in percent, and specific humidities (*q*), in grams/kilogram, obtained by airplanes during October 1937. (Dep. represents departure from "normal" relative humidity)

Station	Altitude (meters) m. s. l.																									
	Surface		500		1,000		1,500		2,000		2,500		3,000		4,000		5,000									
	Number of observations	R. H.		q	R. H.		q	R. H.		q	R. H.		q	R. H.		q	R. H.		q	R. H.		q	R. H.			
		Mean	Dep.		Mean	Dep.		Mean	Dep.		Mean	Dep.		Mean	Dep.		Mean	Dep.		Mean	Dep.		Mean	Dep.	Mean	Dep.
Barksdale Field, La.	26	7.8	84	0	6.7	58	-4	6.1	56	-5	5.2	48	-9	4.4	44	-10	3.6	42	-6	3.2	42	-4	2.0	31	-8	
Billings, Mont.	31	5.0	64	+1					4.9	52	0	4.4	51	+2	3.7	49	0	2.9	48	0	1.9	48	0	1.3	51	+2
Boston, Mass.	27	5.6	79	+4	5.6	77	+8	4.7	72	+7	4.3	71	+10	3.9	71	+14	3.3	65	+12	3.1	65	+14	2.5	66	+18	
Cheyenne, Wyo.	30	4.6	66	+3					4.9	63	+2	4.5	62	+2	4.5	62	+1	3.0	52	+4	2.8	51	+4	1.7	49	+3
Chicago, Ill.	30	5.3	79	-1	5.3	76	+3	4.6	69	+2	3.9	63	+2	3.6	64	+5	3.0	62	+6	2.7	61	+6	2.0	57	+6	
Coco Solo, Canal Zone	26	18.5	96	---	16.8	86	---	15.3	88	---	13.5	86	---	11.8	84	---	10.0	80	---	8.5	78	---	6.5	80	---	
El Paso, Tex.	31	7.1	62	+1					6.5	44	-2	5.7	43	-2	5.0	44	0	4.3	47	+2	3.1	48	0	2.0	39	-5
Fargo, N. Dak.	31	3.6	72	-1	4.2	70	+3	3.9	69	+2	3.6	67	+10	3.1	60	+8	2.8	58	+7	2.4	58	+10	1.7	53	+5	
Kelly Field, Tex.	31	9.6	77	-1	9.5	65	-9	8.0	55	-8	7.4	55	-6	6.5	54	+2	5.2	48	+4	4.4	45	+4	3.0	40	+6	
Lakehurst, N. J.	24	5.3	90	+4	4.7	68	+2	4.2	69	0	3.7	69	+5	3.1	62	+5	2.7	56	+4	2.4	57	+8	1.4	46	+1	
Maxwell Field, Ala.	16	9.0	76	-6	7.9	64	+2	7.5	67	+5	6.3	65	+5	4.9	54	+3	3.2	37	---	2.6	32	-3	2.4	37	+3	
Mitchel Field, N. Y.	21	5.8	83	-3	5.7	77	+2	5.0	77	+5	4.6	77	+9	4.0	69	+9	3.5	66	+8	2.9	63	+8	1.8	49	+1	
Nashville, Tenn.	30	6.8	77	-6	6.2	66	-0	5.6	63	+1	4.6	57	-1	4.2	56	+2	3.7	53	+5	3.2	53	+5	2.2	46	+3	
Norfolk, Va.	20	6.7	78	+1	6.0	64	-2	5.2	65	+1	4.9	65	+8	4.3	58	+7	3.6	54	+8	3.0	51	+10	2.4	49	+18	
Oakland, Calif.	29	8.1	85	---	8.1	66	---	6.4	60	---	4.8	41	---	3.8	36	---	3.1	34	---	2.4	31	---	2.0	33	---	
Oklahoma City, Okla.	31	6.6	73	-8	7.0	62	-10	6.3	54	-6	5.6	51	-6	5.0	50	-3	4.3	49	-1	3.6	47	-0	2.3	41	-3	
Omaha, Nebr.	31	5.4	87	+3	5.4	65	-5	4.9	58	+1	4.4	55	+2	3.9	53	+4	3.6	56	+9	3.1	55	+8	2.2	51	+7	
Pearl Harbor, Territory of Hawaii	31	14.8	77	+9	13.5	78	+1	12.5	84	+4	10.7	79	+4	8.2	66	+2	6.2	50	+4	4.7	47	-1	2.7	28	-4	
Pensacola, Fla.	22	9.7	88	+6	9.4	71	-1	8.4	69	+1	6.9	62	-1	5.3	53	-2	4.5	47	-3	3.6	40	-5	2.2	25	-10	
St. Thomas, Virgin Islands	29	16.6	68	---	16.8	83	---	13.7	85	---	11.7	76	---	10.3	74	---	8.4	65	---	6.4	56	---	3.5	40	---	
Salt Lake City, Utah	31	5.6	65	---	---	---	---	---	---	---	5.6	53	---	5.0	50	---	4.4	52	---	3.8	53	---	2.8	55	---	
San Diego, Calif.	30	9.4	89	+11	9.4	73	+5	7.3	47	-2	5.0	39	-3	4.2	31	-4	3.4	28	-4	2.9	27	-3	2.2	28	+1	
Sault Ste. Marie, Mich.	29	4.3	78	---	4.0	77	---	3.7	83	---	3.1	75	---	2.5	62	---	2.2	60	---	2.0	58	---	1.2	49	---	
Scott Field, Ill.	24	5.0	80	-6	4.8	55	-4	4.4	54	-2	4.0	54	+2	3.2	49	+1	2.9	50	+5	2.5	47	+3	1.9	43	+1	
Seattle, Wash.	9	8.0	81	---	7.8	74	---	7.4	65	---	6.3	57	---	5.0	52	---	4.4	50	---	3.9	47	---	2.6	42	---	
Selfridge Field, Mich.	25	4.7	80	-2	4.5	73	+3	4.0	71	+4	3.6	72	+10	3.0	68	+11	2.6	61	+12	2.2	60	+13	1.6	55	+11	
Spokane, Wash.	31	5.9	86	+4	---	---	---	5.8	68	+3	5.4	68	+8	4.8	70	+11	4.1	69	+11	3.2	63	+8	2.2	62	+10	
Washington, D. C.	26	6.1	80	+3	5.2	65	+1	4.7	62	+2	4.2	64	+7	3.7	61	+7	3.0	54	+6	2.6	52	+8	1.8	46	+12	
Wright Field, Ohio	25	4.9	80	-6	5.0	71	-1	4.5	68	+4	3.9	63	+5	3.6	63	+10	3.1	62	+12	2.6	56	+11	2.0	52	+11	

TABLE 3.—Mean free-air barometric pressures (*P*), in mb, and equivalent potential temperatures (Θ), in °A, obtained by airplanes during October 1937

Stations	Altitude (meters) m. s. l.																							
	Surface		500		1,000		1,500		2,000		2,500		3,000		4,000		5,000							
	Number of observations	P	Θ.	P	Θ.	P	Θ.	P	Θ.	P	Θ.	P	Θ.	P	Θ.	P	Θ.	P	Θ.					
Barksdale Field, La.	26	1,011	307	958	311	903	313	851	315	802	316	754	316	710	317	627	320							
Billings, Mont.	31	892	305					819	312	799	314	752	314	707	313	623	313	548	313					
Boston, Mass.	27	1,016	296	957	301	901	301	847	303	797	305	748	307	703	310	618	314	545	315					
Cheyenne, Wyo.	30	813	309							801	314	753	319	709	319	625	318	551	318					
Chicago, Ill.	30	995	296	957	299	901	301	848	302	797	304	748	305	703	307	618	311	544	315					
Coco Solo, Canal Zone.	26	1,009	349	955	349	902	347	851	345	803	342	756	341	713	339	630	338	558	337					
El Paso, Tex.	31	883	318					851	324	803	324	756	324	711	323	629	323	555	324					
Fargo, N. Dak.	31	983	287	956	294	899	297	845	300	794	302	746	304	700	306	616	309	541	312					
Kelly Field, Tex.	31	993	318	960	323	905	323	853	324	805	325	757	324	713	324	631	325	558	326					
Lakehurst, N. J.	24	1,014	292	959	298	902	299	848	300	797	301	748	303	703	305	618	307							
Maxwell Field, Ala.	16	1,012	314	960	315	905	317	853	316	802	315	755	315	710	316	628	321	555	323					
Mitchel Field, N. Y.	21	1,014	297	958	301	901	302	847	304	797	306	748	308	703	308	619	312							
Nashville, Tenn.	30	996	304	959	307	903	308	850	309	800	310	752	313	707	314	624	316	549	319					
Norfolk, Va.	20	1,018	302	960	306	904	305	850	308	801	310	752	311	707	312	623	317	549	321					
Oakland, Calif.	29	1,016	307	958	316	904	316	852	315	802	315	755	315	710	315	627	318	554	322					
Oklahoma City, Okla.	31	971	306	959	311	904	314	851	316	802	317	755	318	710	318	627	319	553	321					
Omaha, Nebr.	31	981	298	958	303	902	306	849	308	799	309	751	311	706	312	622	315	547	317					
Pearl Harbor, Territory of Hawaii.	31	1,014	336	959	337	905	336	854	334	805	330	758	329	714	328	634	328	560	328					
Pensacola, Fla.	22	1,016	314	960	321	905	321	853	320	804	319	755	319	711	320	629	323	556	325					
St. Thomas, Virgin Islands.	29	1,014	348	959	349	905	345	854	339	806	338	759	336	715	333	634	329	561	331					
Salt Lake City, Utah.	31	874	310					852	316	802	317	754	317	710	317	626	319	546	322					
San Diego, Calif.	30	1,013	313	957	320	903	323	851	321	802	320	756	320	711	321	630	323	556	324					
Sault Ste. Marie, Mich.	29	988	291	955	292	898	293	843	294	791	297	742	299	696	302	611	304	536	307					
Scott Field, Ill.	24	1,002	294	959	301	903	304	849	305	799	306	750	308	706	310	622	314	548	316					
Seattle, Wash.	9	1,019	307	960	312	905	317	852	316	803	318	757	318	712	320	630	321	556	322					
Selfridge Field, Mich.	25	993	292	956	296	898	296	844	298	793	300	744	302	699	304	614	307	539	310					
Spokane, Wash.	31	947	302			903	308	850	311	800	311	751	311	706	311	622	312	547	313					
Washington, D. C.	26	1,018	298	960	301	904	303	850	304	800	306	752	307	706	309	622	312	548	315					
Wright Field, Ohio.	25	988	294	957	299	901	300	847	302	797	304	746	306	703	308	619	312	544	315					

TABLE 4.—Free-air resultant winds (meters per second) based on pilot-balloon observations made near 5 a. m. (E. S. T.) during October 1937

[Wind from N=360°, E=90°, etc.]

Altitude (m) m. s. l.	Albuquerque, N. Mex. (1,554 m)		Atlanta, Ga. (309 m)		Billings, Mont. (1,088 m)		Boston, Mass. (15 m)		Cheyenne, Wyo. (1,873 m)		Chicago, Ill. (192 m)		Cincinnati, Ohio (153 m)		Detroit, Mich. (204 m)		Fargo, N. Dak. (283 m)		Houston, Tex. (21 m)		Key West, Fla. (11 m)		Medford, Oreg. (110 m)		Nashville, Tenn. (194 m)	
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
Surface.....	11	1.5	335	1.0	268	3.0	241	1.8	276	4.1	278	1.3	279	0.1	258	2.0	294	0.8	27	1.2	78	1.8	128	0.5	257	0.9
500.....			323	2.1			264	5.1			310	5.0	246	2.1	281	4.1	311	3.5	132	1.5	89	3.9	93	0.1	241	2.1
1,000.....			316	3.8			261	5.3			306	5.6	275	4.0	291	6.9	302	4.7	113	1.6	113	3.0	150	0.9	277	3.8
1,500.....			306	5.0	266	6.6	262	7.4			293	7.0	267	5.8	284	8.0	302	7.2	334	4.4	134	2.3	172	3.4	234	5.0
2,000.....	251	1.0	291	6.0	282	6.5	264	8.2	279	6.3	293	8.1	273	6.8	289	8.8	309	10.0	326	5.2	119	2.5	179	4.1	294	6.9
2,500.....	275	3.4	284	6.7	288	7.5	254	10.0	290	7.4	294	10.5	255	7.2	294	9.6	313	9.5	331	6.1	130	1.6	197	4.3	297	8.4
3,000.....	286	4.8	280	7.4	296	8.4	271	11.5	297	7.3	284	14.0	250	6.7	297	11.2	313	12.5	332	6.7	83	1.3	197	2.9	284	8.8
4,000.....	278	6.9	301	10.2	308	8.1			298	7.9									299	5.1	34	1.4	240	2.4		
5,000.....	310	6.8							276	3.7									280	4.7						

Altitude (m) m. s. l.	Newark, N. J. (14 m)		Oakland, Calif. (8 m)		Oklahoma City, Okla. (302 m)		Omaha, Nebr. (306 m)		Pearl Harbor, Hawaii ¹ (68 m)		Pensacola, Fla. ¹ (24 m)		St. Louis, Mo. (170 m)		Salt Lake City, Utah (1,294 m)		San Diego, Calif. (15 m)		Sault Ste. Marie, Mich. (198 m)		Seattle, Wash. (14 m)		Spokane, Wash. (603 m)		Washing- ton, D. C. (10 m)	
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
Surface.....	304	1.3	150	0.7	160	0.9	2	0.5			41	3.5	290	1.1	145	2.3	40	0.9	338	1.4	153	1.6	125	0.6	307	1.2
500.....	275	4.1	347	0.4	189	2.0	318	1.2			353	2.1	305	3.0			345	2.8	303	2.3	194	3.5			279	3.6
1,000.....	270	6.3	37	0.7	226	2.3	299	3.7			312	3.6	302	4.4			321	2.4	300	5.1	188	3.6	201	2.3	278	4.9
1,500.....	273	7.2	160	0.6	277	4.4	295	6.3			300	4.2	295	6.9	166	3.0	294	2.1	299	7.3	296	5.0	246	4.1	278	6.9
2,000.....	265	7.5	45	0.4	302	6.0	301	8.3			298	5.7	297	8.0	185	2.2	271	2.6	281	9.3	206	4.2	240	4.2	274	9.3
2,500.....	255	8.3			315	6.6	306	9.3			299	7.0	298	8.8	232	1.9	290	3.5	282	8.5	236	5.8	256	5.1	275	11.3
3,000.....			288	3.5	307	7.1	305	9.9			316	6.7	302	8.1	258	2.7	249	5.3			235	6.7	252	6.6	293	8.8
4,000.....					266	3.3	296	10.4					255	7.3	288	4.0	286	6.1					297	5.8		
5,000.....															272	5.9	301	8.0								

¹ Navy stations.

TABLE 5.—Maximum free air wind velocities meters per second, for different sections of the United States based on pilot balloon observations during October 1937

Section	Surface to 2,500 meters (m. s. l.)					Between 2,500 and 5,000 meters (m. s. l.)					Above 5,000 meters (m. s. l.)				
	Maximum ve- locity	Direction	Altitude (m) m. s. l.	Date	Station	Maximum ve- locity	Direction	Altitude (m) m. s. l.	Date	Station	Maximum ve- locity	Direction	Altitude (m) m. s. l.	Date	Station
Northeast ¹	35.8	WNW	2,410	30	Kylertown	44.8	WNW	3,550	30	Buffalo	29.4	WNW	6,010	9	Boston.
East-Central ²	37.8	WSW	1,150	20	Cincinnati	39.0	SW	4,420	19	Nashville	40.0	SW	5,220	20	Greensboro.
Southeast ³	29.9	WSW	2,500	20	Charleston	33.6	WNW	3,360	24	Atlanta	41.0	W	8,420	29	Tampa.
North-Central ⁴	32.5	WSW	1,370	19	Detroit	34.0	WNW	3,170	30	Detroit	37.3	NW	9,790	14	Fargo.
Central ⁵	33.2	SW	1,040	5	Wichita	42.8	NW	4,660	26	Wichita	38.0	WSW	7,060	5	Omaha.
South-Central ⁶	29.8	N	1,330	18	Amarillo	45.2	NW	4,630	19	Fort Worth	50.0	NW	6,980	19	Abilene.
Northwest ⁷	38.6	SSW	1,550	27	Portland	36.5	WSW	2,850	28	Spokane	37.1	NNE	11,810	7	Portland.
West-Central ⁸	23.2	SSW	2,480	14	Modena	40.7	NW	4,920	19	Rock Springs	51.6	SW	8,690	6	Modena.
Southwest ⁹	25.4	WNW	1,350	20	Havre	40.4	NW	4,390	18	El Paso	48.0	NW	5,420	18	Albuquerque.

¹ Maine, Vermont, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, and Northern Ohio.² Delaware, Maryland, Virginia, West Virginia, Southern Ohio, Kentucky, Eastern Tennessee, and North Carolina.³ South Carolina, Georgia, Florida, and Alabama.⁴ Michigan, Wisconsin, Minnesota, North Dakota, and South Dakota.⁵ Indiana, Illinois, Iowa, Nebraska, Kansas, and Missouri.⁶ Mississippi, Arkansas, Louisiana, Oklahoma, Texas (except El Paso), and Western Tennessee.⁷ Montana, Idaho, Washington, and Oregon.⁸ Wyoming, Colorado, Utah, Northern Nevada, and Northern California.⁹ Southern California, Southern Nevada, Arizona, New Mexico, and extreme West Texas.

RIVERS AND FLOODS

[River and Flood Division, MERRILL BERNARD in Charge]

By BENNETT SWENSON

During October 1937, a month which is normally quite dry, an unusual number of floods occurred in eastern United States. The precipitation during the month was above normal quite generally east of the Mississippi River, except in the upper Lake region and in the extreme Southeast. A narrow band over which from two to three times

the normal precipitation occurred extended from southeastern Pennsylvania and eastern Maryland southwestward to the mouth of the Mississippi River. Because of low river stages and the dry condition of the ground prior to the rains, the floods were generally not severe.

Atlantic Slope drainage.—Light floods occurred in the